PATENT ABSTRACTS OF JAPAN

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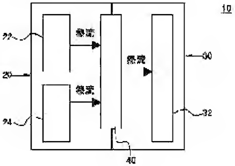
(54) FUEL CELL SYSTEM

(57)Abstract:
PROBLEM TO BE SOLVED: To enhance output density of a fuel cell and starting characteristics of a fuel cell system, in the fuel cell system using the fuel cell as a power supply for a portable electronic apparatus and the like.
SOLUTION: This fuel cell system 10 is provided with an electronic apparatus body 20 equipped with heat generating parts 22, 24, a power supply part 30 equipped with a fuel cell 32 to supply electric power to the electronic apparatus body 20, and a heat transfer means 40 to supply heat generated in the heat generating parts 22, 24 to the fuel cell 32 or its peripheral area. Preferably, the heat transfer means 40 partially heats the air electrode of the fuel cell 32. If the fuel cell 32 is a direct methanol type fuel cell, the heat transfer means 40 preferably supplies heat to a fuel storage container 34 to store the fuel supplied to the fuel cell 32. In addition, the fuel cell system 10 is preferably provided with an auxiliary heating means to heat the fuel cell 32 when starting it.



DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the fuel cell system using the fuel cell as a power supply of portable electronic apparatus, such as a cellular phone, a portable terminal, and a note type personal computer, in more detail about a fuel cell system.
[0002]
[Description of the Prior Art]A fuel cell is a cell which changes directly into electrical energy the free energy change produced when supply of fuel and discharge of products of combustion are performed continuously and fuel burns.
It is classified into various types according to the kind of electrolyte used.
Especially, a polymer electrolyte fuel cell does not have a problem of electrolytic loss, and it has the feature that operating temperature is low and power density is high, as compared with the fuel cell of other kinds. Therefore, the fuel cell system using a polymer electrolyte fuel cell had the application in use to a portability type small electric organ, the mounted source of power, a cogeneration system, etc. conventionally.
[0003]In order to apply a polymer electrolyte fuel cell to such a use, it is necessary to make a fuel cell high-powered. For that purpose, fuel and an oxidizer are compulsorily supplied to a fuel electrode and an air pole, respectively, and it is necessary to make it diffusion of the reacting matter to an electrode not become rate-limiting. It is necessary to manage the moisture content inside a cell appropriately and to control "a dry rise" in which the water content of an electrolyte membrane decreases, and the loss of power resulting from the "flooding" which the fine pores in an electrode blockade with superfluous water. It is necessary to operate a fuel cell by relatively high temperature (80 ** - about 90 **), and to make generation efficiency high.
[0004]Therefore, the conventional fuel cell system using a polymer electrolyte fuel cell, A feed unit for generally supplying superfluous reacting matter to an electrode compulsorily, Many components, such as heating, a cooling system, etc. for maintaining properly the water management device for performing supply of the water to an electrolyte membrane, and discharge and recovery of produced water and the operating temperature of a fuel cell, were needed, and the tendency which the whole system enlarges relatively was suited as the result.
[0005]On the other hand, if reacting matter is supplied only by a free convection to a polymer electrolyte fuel cell and it is made to operate near ordinary temperature, although the output obtained declines, it becomes unnecessary [an excessive component] and can miniaturize the whole fuel cell system remarkably. Although this kind of fuel cell system cannot be used for the mounted source of power as which high power is required, it is thought to the power supply system used for portable electronic apparatus, such as very few cellular phones of power consumption, a portable terminal, and a note type personal computer, that it is effective.
[0006]As a power supply of a portable electronic apparatus, although the rechargeable battery was in use conventionally, there was an idea which a polymer electrolyte fuel cell is operated near ordinary temperature, and is used as substitution of a rechargeable battery from before. For example, to the homepage (http://www.energyrelatedevices.com) of an American energy related device company (Energy Related DevicesInc.). The hybrid power supply (trade name "power holster (trademark, Power Holster^{TM})") which used together the direct methanol fuel cell and rechargeable battery of the type which supplies methanol water to a polymer electrolyte fuel cell as fuel is indicated. This power holster is used equipping a cellular phone.
[0007]For example, to the homepage (http://www.motorora.com/ies/ESG) of U.S. Motorola (Motorola Inc.). The experimental model of the small direct methanol fuel cell which the energy-system group of the company developed in collaboration with the Los Alamos research institute which is National Research Institute of the

U.S. is indicated.
[0008]For example, the fuel system for fuel cells for supplying fuel to the polymer electrolyte fuel cell used as a power supply of a portable electronic device is indicated by JP,10-64572,A. The substance which the fuel system indicated by the gazette reacts to water, such as boron hydride, boron hydride aluminum, and lithium borohydride, and generates hydrogen, By being filled up with water in the container which was divided with the septum and which can be sealed, and adding the water of an initial complement to a hydrogen generating substance through the stoma provided in the septum, when required, hydrogen of a complement is generated.
[0009]For example, to JP,2000-268835,A. When putting the air pole of a polymer electrolyte fuel cell to the atmosphere and supplying air to an air pole by a free convection, in order to prevent a foreign matter from carrying out direct contact to the air pole surface, the generating device which provided the ventilation structure object in the air pole surface is indicated.
[0010]To JP,2000-268836,A. When using liquid fuel, such as methanol water, as fuel supplied to a polymer electrolyte fuel cell, in order to supply liquid fuel to a fuel electrode smoothly, The generating device made to stick the liquid fuel impregnation part for supplying the liquid fuel stored in the fuel stores dept. to a fuel electrode by capillarity to a fuel electrode is indicated.
[0011]
[Problem(s) to be Solved by the Invention]In the conventional technology mentioned above, each fuel cell is used as a power supply which became independent to the last, although installed near the portable electronic apparatus to operate. In order to operate a fuel cell near ordinary temperature, many devices, such as making an air pole into an unreserved structure, are seen.
[0012]However, compared with the case where the power density supplied application-of-pressure air in large quantities, and operates it at an elevated temperature, the actual condition is small about single figure. For example, in the case of the experimental model of the direct methanol fuel cell indicated by the homepage of U.S. Motorola, the power density is presumed to be a 10 mW/cm^2 grade. Therefore, the output obtained is insufficient even if it is a case where it uses as a power supply of a portable electronic apparatus. In particular, when outside air temperature is low, the output of a fuel cell also declines and there is a possibility that sufficient output may not be obtained.
[0013]In the fuel cell system which uses a fuel cell as a power supply of a portable electronic apparatus etc., the issue which this invention tends to solve is in raising the power density of a fuel cell. Even if other issues which this invention tends to solve are when outside air temperature is low, there are in providing the fuel cell system from which sufficient output is obtained.
[0014]
[Means for Solving the Problem]A fuel cell system built over this invention in order to solve an aforementioned problem, Let it be a gist to have an electronic equipment body provided with an exothermic part, a power supply section which equipped this electronic equipment body with a fuel cell which supplies electric power, and a heat transfer means which supplies heat generated in said exothermic part to said fuel cell and/or its periphery.
[0015]If heat discharged from an exothermic part of an electronic equipment body is supplied to a fuel cell and/or its periphery via a heat transfer means, temperature of the fuel cell itself and/or its periphery will rise. As a result, the catalytic activity of a fuel electrode and an air pole improves, and output voltage of a fuel cell increases. If an air pole is heated selectively, discharge of produced water generated by a convection and an air pole of air in an air pole will be promoted. Heating of fuel will also promote diffusion of fuel to a fuel electrode. As a result, oxygen to a catalyst top and supply of fuel become good, and power density of a fuel cell system improves.
[0016]When it has further an auxiliary heating means to heat a fuel cell at the time of start up, even if it is at the time when outside air temperature is low, a fuel cell can be heated in a short time to temperature in which a stable operation is possible, and the starting characteristic of a fuel cell system improves.
[0017]
[Embodiment of the Invention]Hereafter, it explains in detail, referring to drawings for the 1 embodiment of this invention. The key map of the fuel cell system concerning this embodiment is shown in drawing 1. The fuel cell system 10 is provided with the following in drawing 1.
Electronic equipment body 20.
Power supply section 30.
Heat transfer means 40.

The electronic equipment body 20 was provided with the 1st exothermic part 22 and the 2nd exothermic part 24, and the power supply section 30 has the fuel cell 32, and the electronic equipment body 20 and the power supply section 30 are used in the state where it was unified. The heat transfer means 40 has a function which supplies the heat generated in the 1st exothermic part 22 and/or the 2nd exothermic part 24 to the fuel cell 32 or its periphery.
[0018]The electronic equipment body 20 in which this invention is applied is provided with the exothermic part, and should not just be limited in particular for the kind. Specifically, portable electronic apparatus, such as a cellular phone, a portable terminal, and a notebook sized personal computer, are mentioned as a suitable example. The 1st exothermic part 22 and the 2nd exothermic part 24 generate heat at the time of use, and should not just be limited in particular for the kind. Although it changes with composition of the electronic equipment body 20, the 1st exothermic part 22 and the 2nd exothermic part 24 are mentioned as an example with preferred central arithmetic element (CPU), memory chip, display display device, or its back light etc., when it is many.
[0019]In drawing 1, although two exothermic parts are indicated to electronic equipment body 20 inside, this is mere illustration and the number of the exothermic part in the electronic equipment body 20 is not limited to two pieces. Only the heat which may supply the heat generated from all the exothermic parts contained in the electronic equipment body 20 to the fuel cell 32 and its periphery, or is generated from some exothermic parts may be supplied.
[0020]The fuel cell 32 with which the power supply section 30 is equipped operates near ordinary temperature, and should not just be limited in particular for the kind. Specifically as the fuel cell 32, a polymer electrolyte fuel cell is mentioned as a suitable example.
[0021]The fuel cell 32 may be a type with which the gaseous fuel which contains hydrogen as fuel is supplied, Or it may be a type with which the liquid fuel which consists of a mixture of the fluid organic compound and water containing oxygen, such as methanol, ethanol, propanol, formic acid, sodium formate, formaldehyde, and ethylene glycol, is supplied. Fuel is cheap, especially the fuel cell of the type which supplies methanol water as fuel, i.e., a direct methanol fuel cell, and it is easy also for the storage, and under catalyst existence, since electrochemical reaction advances comparatively easily near a room temperature, it is preferred as a power supply for portable electronic apparatus.
[0022]Storage and the feeding method of fuel should just choose the optimal method according to the kind of fuel to be used. For example, when using hydrogen gas as fuel, hydrogen gas may be stored in the small cylinder, or occlusion may be carried out into the hydrogen storing metal alloy. Chemical hydrides, such as sodium borohydride, may be stored in either of the power supply sections 30, and the hydrogen gas taken out from this chemical hydride may be supplied to a fuel electrode (not shown). It is good to adjoin the fuel cell 32, to provide a fuel storage container, and to store liquid fuel in this fuel storage container for example, when using liquid fuel including methanol water as fuel.
[0023]Any of pure oxygen or air may be used as an oxidizer supplied to the air pole (not shown) of the fuel cell 32. However, when using pure oxygen as an oxidizer, the container for storing this is needed separately. Therefore, in order to miniaturize the whole system, it is preferred to use air as an oxidizer. When using air as an oxidizer, an air pole changes into the state where it was exposed to the atmosphere, and air should just be supplied to the air pole surface by the free convection. When using for heating of the fuel cell 32 the air discharged from a cooling fan so that it may mention later, it may be made to supply the exhaust air from a cooling fan to the air pole side directly.
[0024]The heat transfer means 40 is for supplying the heat generated in the 1st exothermic part 22 and/or the 2nd exothermic part 24 to the fuel cell 32 or its periphery. As for the portion which supplies heat via the heat transfer means 40 among the fuel cell 32 or its periphery, it is preferred to choose the optimal portion according to the characteristic etc. which are required of the kind of the structure of the fuel cell 32, the mode for which the fuel cell 32 is used, and fuel to be used, and the fuel cell 32.
[0025]For example, it depends for the output voltage of the fuel cell 32 to the catalytic activity of the catalyst included in a fuel electrode and an air pole strongly. It is known that this catalytic activity will generally become so high that temperature rises. Therefore, in order to improve the catalytic activity of an electrode and to obtain high output voltage, it is preferred to supply heat to the fuel cell 32 whole via the heat transfer means 40.
[0026]For example, when using liquid fuel, such as methanol water, as fuel, since the fluid organic compound used as fuel is consumed by a cell reaction, the liquid fuel near the fuel electrode is in the state where the concentration of the fluid organic compound fell. If this is neglected, diffusion of the fluid organic compound to a fuel electrode will become rate-limiting, and output voltage will be reduced. In a fuel electrode, CO_2 gas is

emitted as a by-product at the time of power generation. If this CO_2 gas serves as air bubbles and adheres to a fuel electrode, the diffusion to the fuel electrode of a fluid organic compound will be barred, and output voltage will be reduced.

[0027]Therefore, in such a case, it is preferred to supply heat to the fuel storage container which stores liquid fuel or this via the heat transfer means 40. If heat is supplied to liquid fuel or a fuel storage container, a convection will occur inside liquid fuel and the concentration of the fluid organic compound contained in liquid fuel by this convection will equalize. Discharge of CO_2 is also promoted by the convection. As a result, diffusion of the fuel to a fuel electrode can be promoted.

[0028]On the other hand, when using hydrogen gas as fuel, in order to attain a high increase in power, heat is supplied to fuel cell 32 the very thing, and it is made more effective [for operating temperature to rise rather] than to supply heat to fuel via the heat transfer means 40. However, when using a hydrogen storing metal alloy as a storage condition of hydrogen gas, it is effective to supply heat to the hydrogen storing metal alloy itself. The hydrogen desorption reaction of a hydrogen storing metal alloy is an endoergic reaction, and this is for the amount of hydrogen desorption to increase so that the temperature of a hydrogen storing metal alloy becomes high.

[0029]Partial heating of an air pole is more effective than supplying heat to the whole air pole uniformly via the heat transfer means 40 for example, when supplying air to an air pole by a free convection rather. When partial heating of an air pole is performed, it is for a free convection to be promoted by the warmed air and for an air flow rate to increase with it. The increase in an air flow rate promotes discharge of the water generated by an air pole, and it is effective in reducing air pole polarization notably.

[0030]Next, the example of the heat transfer means 40 is explained. As the 1st example of the heat transfer means 40, the heat transfer member which joins the 1st exothermic part 22 and/or the 2nd exothermic part 24, and the fuel cell 32 or its periphery is mentioned as a suitable example. In this case, in the construction material of a heat transfer member, calorific capacity is large, thermal conductivity is high in it, and it is desirable in it to use a cheap material moreover. Specifically, copper or a copper alloy is mentioned as a suitable example.

[0031]A heat transfer member is good to define the shape so that heat may be most efficiently supplied to the portion made into the purpose. For example, the field (this is hereafter called "heat generation surface".) which emits most many heat among exothermic parts is a flat surface, And what is necessary is just to join a heat generation surface and a heat-receiving side via a plate-like heat transfer member, when the field (this is hereafter called "heat-receiving side".) of a portion to supply heat to among the fuel cell 32 or its periphery is also a flat surface.

[0032]For example, about the fuel electrode provided in one field of the electrolyte membrane. About the air pole which crossed to the whole surface, supplied heat uniformly, and was provided in the field of another side. What is necessary is for L type, U type, a cube type, etc. to make a heat transfer member the cubic shape according to distribution of the heat-receiving side, and just to join at least 1 of two or more heat-receiving sides, and a heat generation surface via a heat transfer member like [in the case of supplying heat selectively], when two or more heat-receiving sides are distributed in three dimensions. In this case, other heat-receiving sides and heat transfer members of it being close are good, or may be joined.

[0033]As the 2nd example of the heat transfer means 40, when air cooling of the 1st exothermic part 22 and/or the 2nd exothermic part 24 is carried out by the cooling fan, the blowing means which introduces into a heat-receiving side the air discharged from a cooling fan is mentioned as a suitable example. Since it is heated by the 1st exothermic part 22 and/or the 2nd exothermic part 24, the air used for cooling of the 1st exothermic part 22 and/or the 2nd exothermic part 24 can heat the fuel cell 32 or its periphery efficiently, if this is introduced into a heat-receiving side.

[0034]In this case, the fuel cell 32 or its whole periphery may be heated using a blowing means, or it may be made to heat a part. It is preferred especially to supply the air discharged from a cooling fan to an air pole. An air flow rate increases and discharge of produced water is also efficiently performed at the same time fuel cell 32 the very thing will be heated, if the air heated by the 1st exothermic part 22 and/or the 2nd exothermic part 24 is supplied to an air pole. Therefore, supply of oxygen to a catalyst top becomes good, and high output voltage is obtained.

[0035]What used together heating of a heat-receiving side using the heat transfer member as the 3rd example of the heat transfer means 40 and heating of the heat-receiving side using a blowing means is mentioned as a suitable example. If a heat transfer member and a blowing means are used together, even if it is a case where heating sufficient by just the heat flow rate that moves to the fuel cell 32 from a heat transfer member is not made, the operating temperature of the fuel cell 32 can be raised and improvement in much more battery

capacity will be attained.
[0036]The calorific value of a portable electronic apparatus is fluctuated depending on the amount of information processing. This tendency acts effectively to this invention. This is for the temperature of the fuel cell 32 to rise and for output characteristics to improve as the time which needs electric power. However, when the amount of information processing becomes superfluous, there is also a possibility that the demand-and-supply balance of electric power may collapse. Therefore, it is preferred to consider it as the fuel cell system of the hybrid type provided with the capacitor or the small rechargeable battery, and to make it stabilize demand-and-supply balance using a capacitor or a small rechargeable battery in such a case.
[0037]When outside air temperature is very low, a long time may be taken for the temperature of the fuel cell 32 to rise to stable operation temperature. Therefore, it is preferred to form an auxiliary heating means to heat the fuel cell 32 and/or its periphery at the time of start up in such a case. A heater is heated using the rechargeable battery for start up for example, as an auxiliary heating means, and what carries out direct heating of the fuel cell 32 and/or its periphery with this heater is mentioned as a suitable example.
[0038]The 1st example of the fuel cell system concerning this invention is shown in drawing 2. The fuel cell system 12 is provided with the following in drawing 2.
Electronic equipment body 20a.
Power supply section 30a.
Heat transfer members 40a and 40b.
The electronic equipment body 20a is provided with the following.
It is a cellular phone or a personal digital assistant, and is the liquid crystal display section 22a.
The integrated circuit unit 24a mounted on the circuit board parts 26.
In the example shown in drawing 2, the liquid crystal display section 22a and the integrated circuit unit 24a are used as the 1st exothermic part and the 2nd exothermic part, respectively.
[0039]The power supply section 30a has the direct methanol fuel cell 32a, and the fuel storage container 34 is formed in the anode side of the direct methanol fuel cell 32a. The fuel storage container 34, and the liquid crystal display section 22a and the integrated circuit unit 24a are joined by the plate-like heat transfer members 40a and 40b, respectively. Therefore, at the time of steady operation, the heat generated in the liquid crystal display section 22a and the integrated circuit unit 24a is supplied to the fuel storage container 34 via the heat transfer members 40a and 40b.
[0040]The 2nd example of the fuel cell system concerning this invention is shown in drawing 3. The fuel cell system 14 is provided with the following in drawing 3.
Electronic equipment body 20a.
Power supply section 30a.
Heat transfer members 40a and 40c.
Among this, since the electronic equipment body 20a, the power supply section 30a, and the heat transfer member 40a are the same as that of the fuel cell system 12 shown in drawing 2, explanation is omitted.
[0041]The heat transfer member 40c connects the both side surfaces of the plate-like joined part 42a and the plate-like air convection fin 42b by two or more connecting parts 42c of the shape of KO, and 42c--, as shown in drawing 4. The direct methanol fuel cell 32a and the fuel storage container 34 are inserted into the joined part 42a, the air convection fin 42b and the connecting part 42c, and the space that comprises 42c--. The integrated circuit unit 24a and the fuel storage container 34 are joined via the joined part 42a of the heat transfer member 40c. The air convection fin 42b has a wrap size, it approaches an air pole and the bottom half of the air pole of the direct methanol fuel cell 32a is arranged.
[0042]Therefore, at the time of steady operation, the fuel storage container 34 is heated with the heat supplied via the heat transfer members 40a and 40c from the both sides of the liquid crystal display section 22a and the integrated circuit unit 24a. A part of heat generated in the integrated circuit unit 24a is told to the air convection fin 42b via the joined part 42a and the connecting part 42c, and 42c--, and the bottom half of an air pole is heated by the air pole convection fin 42b. Therefore, the air heated in the bottom half of the air pole goes up toward the upper half of an air pole, and the free convection of air is promoted.
[0043]Next, an operation of the fuel cell system concerning this embodiment is explained. The output voltage obtained from a fuel cell differs according to the operating condition, and, generally the output to which made it bigger [to supply application-of-pressure air in large quantities at an elevated temperature] is obtained. Therefore, if a fuel cell is started near ordinary temperature and air is supplied only by a free convection, a fuel cell system can be miniaturized, but loss of power is caused. On the other hand, the portable electronic apparatus is provided with the exothermic part with large calorific value, such as CPU and a display display

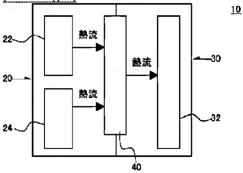
device, and is like [which needs to cool using a fan] in some [, such as a personal computer,] apparatus.
[0044]Therefore, if the heat discarded from the exothermic part of the electronic equipment body is supplied to a fuel cell and/or its periphery via a heat transfer means and it reuses to heating of a fuel cell, the catalytic activity of a fuel cell will improve and a high output will be obtained. Since a fuel cell can be heated without using a large-sized component, enlargement of the whole fuel cell system is avoidable.
[0045]In addition to heating of the whole fuel cell, replace with this, and if partial heating of an air pole, heating of the fuel itself, air blasting to the air pole of the air discharged from a cooling fan, etc. heat the periphery of a fuel cell, The fuel to the catalyst top of a fuel electrode and/or an air pole and supply of oxygen become good, and the output of a fuel cell improves further.
[0046]
[Example](Example 1) As shown in drawing 2, the fuel cell system which joined the liquid crystal display section of electronic equipment and the integrated circuit unit, and the fuel storage container of the direct methanol fuel cell by the copper plate-like heat transfer member was produced. The direct methanol fuel cell used what joined the fuel electrode and the air pole for both sides of the electrolyte membrane which consists of Nafion (the Du Pont make, registered trademark) 117. To the catalyst bed of the fuel electrode, the Pt-Ru alloy catalyst which carbon was made to support was added at a rate of 3 mg/cm^2, and Pt catalyst which carbon was made to support was added at a rate of 2 mg/cm^2 to the catalyst bed of the air pole at it. The methanol water stored in the fuel storage container was supplied to the fuel electrode, and air was supplied to the air pole by the free convection. When such a fuel cell system was operated, at the time of steady operation, fuel cell temperature became 40 ** and the current density in the cell voltage 0.3V was 70 mA/cm^2.
[0047](Example 2) As shown in drawing 3, the liquid crystal display section of electronic equipment and the fuel storage container of a direct methanol fuel cell are joined by a copper plate-like heat transfer member, The fuel cell system joined by the copper heat transfer members provided with the air convection fin for heating the bottom half of an air pole for the integrated circuit unit and a fuel storage container was produced. What has the same structure as Example 1 was used for the direct methanol fuel cell. When such a fuel cell system was operated, at the time of steady operation, the temperature of the air convection fin was 35 **. The current density in the cell voltage 0.3V is 80 mA/cm^2, and the high output was obtained as compared with Example 1. This is because the free convection of air was promoted by heating the lower half of an air pole.
[0048](Comparative example 1) The fuel cell system which has the same structure as Example 1 was produced except not having joined the liquid crystal display section of electronic equipment and the integrated circuit unit, and the fuel storage container of the direct methanol fuel cell by a heat transfer member. When such a fuel cell system was operated, at the time of steady operation, fuel cell temperature was 30 **. The current density in the cell voltage 0.3V is 40 mA/cm^2.
The output declined from Example 1 and Example 2.

[0049]As mentioned above, although the embodiment of the invention was described in detail, various changes are possible for this invention within limits which are not limited to the above-mentioned embodiment at all, and do not deviate from the gist of this invention. For example, although the fuel cell system concerning this invention is especially preferred as a power supply system for portable electronic apparatus, the scope of this invention is not limited to this, and can be applied also as a power supply system of fixed type electronic equipment.
[0050]
[Effect of the Invention]Since the fuel cell system concerning this invention is provided with the electronic equipment body provided with the exothermic part, the power supply section which equipped the electronic equipment body with the fuel cell which supplies electric power, and the heat transfer means which supplies the heat generated in an exothermic part to a fuel cell and/or its periphery, The temperature of the fuel cell itself and/or its periphery rises, and it is effective in high output voltage being obtained.
[0051]When it has further an auxiliary heating means to heat a fuel cell at the time of start up, it is effective in the starting characteristic of a fuel cell improving. When an air pole is selectively heated using a heat transfer means, the free convection of air is promoted and it is effective in the power density of a fuel cell improving. A fuel cell is a direct methanol fuel cell, and in being what supplies heat to the fuel storage container for storing the fuel in which a heat transfer means is supplied to a fuel cell, diffusion of the fuel to a fuel electrode is promoted and it is effective in the power density of a fuel cell improving.

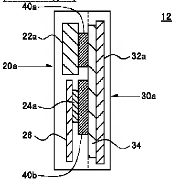
[Translation done.]

DRAWINGS

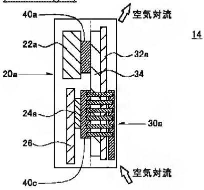
[Drawing 1]



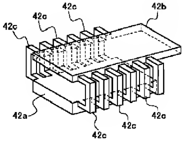
[Drawing 2]



[Drawing 3]



[Drawing 4]



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